CPD Department Overview
Group Structure

Advanced Physics Software

– Mark Fischler

Analysis Tools and Visualization

– Philippe Canal

Simulation

– Panagiotis Spentzouris

Experimental Physics and Computing

– Patricia McBride, Suzanne Panacek

http://www-cpd.fnal.gov

Advanced Physics Software

Group Members:

– Walter Brown, Mark Fischler, Jim Kowalkowski, John Marraffino, Marc Paterno, Dave Sachs, (Liz Sexton Kennedy), Jim Simone

Projects and Activities:

– C++ Class Library Development and Support
  - ZOOM
  - CLHEP (with CERN and SLAC)
  - BOOST
– C++ Support
  - C++ Working Group
  - C++ Consulting
  - C++ Standards Committee
  - C++ Classes from Walter Brown
– Lattice QCD software support (separate presentation)

C++ Libraries For HEP

Zoom & CLHEP (wwwinfo.cern.ch/asd/lhc++/clhep/)

- CLHEP was originally an international collaboration; then became a component of the LHC++ project
- CPD members are editors of about half the packages, and contributors to a couple of others; some of these packages were originally developed for ZOOM

Heavily used CLHEP packages:

- Random (Editor mf)
- Matrix   (mf has been inserting fixes and speed-ups)
- Vector   (merged with the Zoom PhysicsVectors)
- HepPDG/HepMC/StdHEP (Lynn Garren)
  - A new product but since it brings a popular standard into C++ we are confident it will see heavy use if well supported (HepMC in use at LHC already)

Zoom Packages

The majority of packages in the ZOOM Class Library are in production

www.fnal.gov/docs/working-groups/fpcltf/Pkg/WebPages/zoomReal.html

Summary of ZOOM packages:

- The most widely used ZOOM packages:
  - ErrorLogger
  - HepTuple
    - by far the largest user-support required
  - ISOcxx (cross-platform portability)
  - PhysicsVectors (= CLHEP Vector)
- Other "production" status ZOOM packages
  - "Production" implying maturity, testing, change-control, and effort tracking
  - Exceptions, LinearAlgebra, SpecialFunctions
  - ZMtimer, ZMtools (small tools), ZMutility

Newer Zoom Packages

ZOOM packages In "beta" status

– Allocator (for faster std::vector creation, etc.)

– HepPDT, HepMC, StdHEP

– CovMatrices (lean and mean for tracking)

New Packages under development

– Minimization

  • Minuit capability and more, in true C++ design

– Splines

For convenience of access, some Non-Zoom packages are also in ZOOM repository

– RCP (Run Control Parameters, used by CDF, D0, MiniBoone, …)

Zoom/CLHEP Coordination

Zoom and CLHEP are have been moving toward more commonality

- Significant proposal from ZOOM side will be coming
  - But this depends first on resolving "Zoom Export" issues
- We would like to make ZOOM available to the LHC experiments

CLHEP is currently not well supported at CERN

- It is possible that a new coordinating editor will be chosen, possibly a CPD person
- Discussions with the LCG/LHC experiments needed
  - Workshop at CERN is under discussion
-

FNAL in the C++ Community

The goal is to influence the outside C++ community so that developments favorable to our usage in HEP are encouraged

- Numerical/scientific computation needs have traditionally been under-represented (Bj. S.)

FNAL is part of the C++ standards committee

- W. Brown/ M. Paterno

Participation in Boost

- A consortium that provides established "prior art" designed well enough that it can be considered for inclusion in the Standard
- E.g., Boost::random

The (Reconstituted) C++ Working Group

M. Paterno is currently the working group leader
Major priorities

- Resolve any impediments to replacing KCC with gcc
  - Any compilation deficiencies
    - (mostly or all dealt with)
  - Linking time/memory problems
    - D. Sachs investigating; major progress; not yet fully nailed
- Improve deficiencies which slow down developers
  - Lack of good and industrial-strength debuggers in some cases
  - Lack of memory/bounds checking tools for huge programs
  - Lack of profiling tools that can work with large executables

APS "Special Assignments (Sub)Group"

Paterno, Kowalkowski, Sexton-Kennedy

– This group meets every two weeks with MF and PLM; previously directed by Steve Wolbers

Major responsibilities:

– General support for CDF, D0 software

– Design work for newer/future experiments

– Community computing support

– CDF infrastructure

General Support for CDF and D0

Goal:

– *"continually exert pressure to try to move toward commonality"*

Activities:

– Diagnose and fix problems in existing code
– Discover and provide missing capabilities
  - Design and often, of necessity, implement
– Physical design
  - organization
  - linkage
– Database issues
– Data organization
  - EDM into form suitable for direct root usage
– Extending infrastructure
– Lots of little projects for individual developers and users
  - Spend a few hours to save people days

Design work for other experiments and future projects

Goal:

– *"Don't want to remain primary developers, but time put in at the beginning has a disproportionately good effect"*

Projects supported:

– MiniBoone

– BTeV framework and EDM

– Linear Collider

- Almost no involvement because of lack of time

– Isolated other projects – design and guide implementation

- DB server re-implementation (D0)
- Database statistics (CDF)
- BTeV Embedded (online) framework

Community computing support

Goal:
- *"no customer will explicitly ask for this, but many will benefit if it is available"*

Continually Searching for forward-looking projects
– e.g., how to make sensible use of sharable libraries

Memory tracker
– now "indispensible" for D0

Detailed profiling availability
– (future)

Analysis Tools and Visualization

Group:

– Philippe Canal, Jeff Kallenbach, Pat Pomatto*, Gary Roediger*

*contract for CRL support

Projects and Activities:

– Root development and support
– Histoscope support
– CRL Development and support
– HEPBook development**
– HEPVis support, support of graphics tools
– MiniBooNE event display
– Tosca/Opera
– Visualization Room and Lederman Center support

**Development supported by SBIR

ROOT Support

Support of end users
- CDF, D0, MiniBooNE, BTeV, CMS, etc.

Participation in the code development
- ROOT I/O sub-system, in particular solution to experiment specific problems (speed for CDF, generality for D0).

Regular releases for CDF, D0, MiniBooNE, etc.

Help with design/development of ROOT based I/O sub-systems
- for experiments (MiniBooNE, D0, CDF)

Infrastructure support:
- Organize by-weekly experiment meetings
- maintain FNAL ROOT web pages
- Participate in occasional ROOT workshops
- Documentation (now supported at CERN)
- Educational resources: http://www-cpd.fnal.gov/root/

Control Room Logbook

http://www-cpd.fnal.gov/CRL/

Roediger, Pomatto, Philippe, Leininger, Panacek

First deployed at D0 in early 2001

CRL is now used by many experiments

– D0, MiniBooNE, Minos, BTeV test beam

The project is mainly in support phase.

Recent development work

– Each new experiments had a few new requirements: forms, auto-scheduling, etc

– Many ease of use (searching/presentation) have been addressed

– Currently addressing packaging and installation issues

Graphics and Visualization

HepVIS

– Releases for CDF, D0, MiniBooNE, etc.

– Development of custom event displays for experiments (MiniBooNE being the latest)

Support/maintain graphics software

– Open Inventor, open open inventor, opengl, mesa

Visualization Room (Wilson Hall Ground)

– maintain hardware

– coordinate and develop visual demos

– Train/help public affairs

Lederman center

– Support and help with some of the visualization demos

Other Activities for ATV

Histoscope

- No new development
- Answer user questions (mainly from outside FNAL)

HepBOOK

- Will eventually replace the CRL
- New design with emphasis on distributed use and will have enhanced search capabilities
- SBIR funding granted Summer 2002
- CPD has promised to provide help with packaging and deployment in the experiments

Simulation

Group:

- Jim Amundson, Daniel Elvira, (Lynn Garren), (Paul Lebrun), Steve Mrenna, (Adam Para), Panagiotis Spentzouris

Projects and Activities:

- Neutrino Factory Beams Simulation*
- CMS Simulation (Validation with test beam)
- SCIDAC Accelerator Simulations
- Generator support, Interfaces to Generators
- Geant3/4 support + testing
- MCFast support
- LC simulations (no active participation at this time)

*Projects essentially complete

Simulation Support

Provide standard HEP simulation tools to the FNAL community

- Pythia, Herwig, Isajet, QQ, STDHep, MCFast, Geant3, Geant4 in kits

Provide consulting and support to the experiments for physics generators (see talk by Steve Mrenna)

Provide/develop tools for beams simulations

- Neutrino factory project (nearly complete)
- SCIDAC project

Neutrino Factory Support

(Daniel Elvira, Paul Lebrun, Panagiotis Spentzouris

CPD was a member of the MuonCollider/Neutrino Factory Collaboration for several years

- The neutrino factory study projects that had been undertaken by CPD members are now finished.
- CPD will no longer play a major role in these activities
  - Members of the simulation group will act as consultants to the neutrino factory study group if more work is done on any of the studies that our group has done in the past.

Daniel has recently released a set of general "Beam Simulation Tools" based on G4

- http://www-cpd.fnal.gov/geant4/G4BeamTools/
- The group plans support this code for the Neutrino Source collaboration.
- It will also be used as part of a test suite for GEANT4.

Simulation Studies

Neutrino Factory Studies (Muon collider)

– Neutrino Factory studies and cooling R&D continue in PPD but CPD is no longer active in simulation studies.

– The group will provide some support for tools that were developed.

SCIDAC Accelerator studies

– See talk by Panagiotis Spentzouris

Studies for future projects/experiments

– Steve Mrenna has been involved in workshops

– No plans for simulation software support at this time

- May do some consulting, but will not be a high priority

Experimental Physics and Computing

Group:

- Lynn Garren, Liz Buckley-Geer, Robert Kutschke, Robert Hatcher, Paul Lebrun, Mark Leininger, Patricia McBride, Suzanne Panacek, Adam Para, Julia Yarba

Projects and Activities:

- CDF
- Minos
- BTeV
- Beams
- Off-axis neutrino detector (See presentation by Adam Para)

CDF Infrastructure Support
(Liz Sexton-Kennedy)

Liz Sexton-Kennedy's role in CDF:

– Deputy Offline Analysis Coordinator

Light support for infrastructure

– "every once in a while do something to framework which everybody appreciates, but was quick job"

Heavy Support for FrameMods

– Modules that perform services:

- I/O, configuration management, database management
- ErrorLogger management, HepTuple/Root management
- Geometry management, Myron-mode module

CPD Minos Support

Liz Buckley-Geer, Robert Hatcher, Mark Leininger

- Simulation support
  - Design and develop new simulation framework in C++
  - Re-implement MINOS geometry classes using new ROOT geometry
  - Implement MINOS geometry in ROOT if above exploration successful.
- Ongoing user software consulting, bug fixing, support of existing packages, etc.
- Provide support for NuMI users on W2K systems and Linux
- Planning for MINOS offline computing

BTeV Activities in CPD

- Mark Fischler, Lynn Garren, Rob Kutschke, Paul Lebrun, Patricia McBride, Julia Yarba and others

Simulation studies

- L2/L3 trigger studies
- Physics studies needed for reviews

Development of software infrastructure

- Simulation package in G3 and tests of G4
- Currently developing a set of C++ examples for analysis software
  - Framework and EDM prototypes have been developed with the help of JimK and MarkP
- Parameter Book was developed
  - Will interface with Geometry manager
  - Currently on hold
  - Development will pick up again after P5 committee approval and Beams work is

BTeV Activities in CPD

Computing infrastructure

- Work with OSS in support of fnsimu1/2 and new web server
- Planning for L2/L3 trigger hardware

Other activities

- Protvino Ecal test beam support and analysis
- RTES (See presentation by Jim Kowalkowski)
- Web page and documentation support

Research Activities of Scientific Staff

Liz Buckley-Geer
- Minos

Daniel Elvira
- D0, CMS

Mark Fischler
- BTeV

Rob Kutschke
- Focus, BTeV

Paul Lebrun
- Beams, BTeV, E687

John Marraffino
- CMS

Patricia McBride
- KTeV, BTeV

Steve Mrenna
- Theory

Adam Para
- Minos, Off-axis neutrino detector

Jim Simone
- Lattice QCD

Panagiotis Spentzouris
- NUTeV, MiniBooNE

Other Department Activities

Effort Reporting for CD (Panacek)

Beams Division Support

- – SDA Application Support (Lebrun, Panacek)
- – SDA Analysis (Lebrun)
- – Orbit Smoothing (Fischler, Kallenbach)
- – Tune Meter Studies (Lebrun, Marraffino)
- – Documentation database ?

Liaisons to other experiments

- – KTeV (McBride), MiniBooNE(Spentzouris)

CERNLIB support (Marraffino, Garren)

SC2002 (Canal, Kallenbach, Elvira, Spentzouris, Simone...)

Other Presentations

Support for LatticeQCD
  – Jim Simone

Off-axis neutrino experiment
  – Adam Para

Patriot Project and Physics generator support for Run II
  – Steve Mrenna

RTES
  – Jim Kowalkowski

SCIDAC Accelerator Simulations
  – Panagiotis Spentzouris